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RESEARCH PAPER

Financial viability and conservation role of betel leaf based agroforestry: an indigenous hill farming system of Khasia community in Bangladesh

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Abstract: A study was conducted to investigate the cultural and financial management techniques of betel leaf based agroforestry system practiced in or near homegardens of Khasia community in Jaintapur Upazila in the district of Sylhet, Bangladesh. The Khasia is an educated community where 100% of Khasia people were literate, a stunning fact for this ethnic community in Bangladesh. The average family size in the study area was 7.68, with a ration of male and females of 141:100. The homegardens of the Khasia are rich in species composition, which 15 timber species, 22 horticultural species, six medicinal species, 13 annual crops including leafy vegetables, seven species of spices and five species of bamboo were identified along with betel leaf. The Khasia is an economically prosperous community with the minimum family incomes of Tk 4 000 per month (Tk. 70=1 US Dollar). Betel leaf based agroforestry is very common being a prevalent source of income. About 95.45% of the households are involved in betel leaf husbandry. The mean annual income from one hectare of betel leaf plantation was estimated to be Tk. 80979. This practice was proven to be a profitable business where the benefit cost ratio was calculated to be 4.47. Moreover, the species composition in the betel leaf plantation area (the forest area once utilized by Khasia for shifting cultivation) was found to be very promising to play the significant role in conservation of biological diversity making the practice a sustainable agroforestry system.

Keywords: agroforestry; betel leaf; conservation; homegarden; Khasia

Introduction

Bangladesh is a country of racial heterogeneity comprising of almost 98% Bengalispeaking people, and most of which are Bengalis. Yet there are 27 to 29 ethnic minorities commonly known as tribal community or indigenous people constituting 1.13% of the total population (Khaleque 1995; BBS 1991). The tribal communities of Bangladesh are concentrated in the north and northeastern borders, north central region and the greater Chittagong Hill Tracts (Khan 1998), primarily in and around forest areas (BBS 1991). Khasia, a culturally distinct tribe with a population of 12 280 (BBS 1991) who migrated from Assam about five hundred years ago, inhabits in the hilly area of northeastern region.

Traditionally, like other tribal communities, Khasia used to practice shifting cultivation for many years (Bareh 1967). However, because of integration into mainstream society, they have now developed their own market oriented sustainable tree-crop production system (Nath et al. 2003). For instance, Garo communities have shifted from shifting cultivation to agroforestry in the plain land Sal forest (Khaleque and Gold 1992). Agroforestry is a land use system that involves socially and ecologically acceptable integration of trees with agricultural crops and /or animals. Simultaneously or sequentially it can increase the productivity in a sustainable manner from a unit of farmland, especially under conditions of low levels of technology inputs and marginal lands (Nair 1985). According to the definition by Zabala (1990), agroforestry is any sustainable land use system that maintains or increases total yields by combining food crops with trees and/or livestock on the same unit of land. The main objectives of this approach is sustainable land use where agricultural, forest crops and /or animals are raised in the same unit of land that are compatible with the cultural patterns of the local population (Alam et al. 1997). Different tribal communities of the world practice various types of agroforestry farming systems for their livelihood. Livelihood of many Khasia is now highly dependent on betel leaf based agroforestry production system. Betel leaf (*Piper betel* L), cultivated by Khasia, is a tropical creeper belonging to the pepper family of plants named Piper (Saha and Azam 2004). Betel leaf production is almost throughout Bangladesh and neighbouring countries. The Khasia usually grow betel leaf both in homegarden and forest areas. At least 13 species of Piper are grown in Sylhet forest (Alam and Mahiuddin 1992) but only the

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Piper betel L. produces betel leaves. Betel leaf production by Khasia provides for home consumption and increases income, and hence adds to socio-economic status of village household (Sharma 1999). Both male and female are involved in the production system based on mutual cooperation though Khasia is a matriarchal society (Nawaz 2004).

Homegarden agroforestry is an ancient and widespread agroforestry system in Bangladesh. It is an appropriate form for indigenous agroforestry, found most often in tropical and subtropical areas where subsistence land use systems predominate (FAO 1982). Cropping patterns depend on the owner choice, farm size, availability of planting materials and financial capacity etc. (Nair 1989). In homegarden agroforestry, farmers are mainly interested to grow multipurpose tree species (MPTs), with special preference to fruit trees species (Millatt-E- Mustafa 1996). In the homegardens of Khasia, betel leaf is a main product. Ahmed (1995) identified that betel leaf based agroforestry by Khasia was a viable non-wood forestry production systems.

In the forest, betel leaves are cultivated by using straight bole trees or shrubs as support or host plant. The betel vines climb the trees. The trees provide partial shade. When the tree canopy is closed, pruning is implemented to reduce the shade intensity. New seedlings are kept in the coming years to use as support trees. It is a compatible integration of biological and social systems (Alam and Mahiuddin 1992). This agroforestry practice provides resources to meet people needs for food, fuel wood, shelter, income, employment opportunity, medicinal values and balanced diet though the number of plant per unit area of homegarden gradually decreased (Chowdhury 1993).

Turning from the traditional shifting cultivation to existing agroforestry system has thus not only stopped the disastrous stress on forest but also ensured environment friendly and sustainable income, generating activities, providing opportunity for uplifting socio-economic condition of the Khasia and conserving our valuable forest. The present study was undertaken to investigate the financial viability and conservation role of betel leaf based agroforestry system practiced by Khasia in Bangladesh.

Materials and methods

An exploratory survey on the agroforestry farming system was practiced by Khasia tribal community in Sylhet. Sylhet district was selected randomly. Most of the Khasia in Sylhet live in the sub-district Jaintapur, a region at the border of Bangladesh and India. Therefore, Jaintapur was selected purposively. The specific study unit and the respondents were selected by a multistage random sampling. Inter personal i.e. face to face communication method was applied during the interviews. The key issues covered by the interview included the demography, species composition both in the homegarden and Jhum (hill forest used for shifting cultivation) area, management system of homegarden and betel leaf plantation, financial viability of the betel leaf based agroforestry system etc. The following equation is used for financial analysis of the betel leaf plantation.

$$V_0 = V_t(1+i)^t \quad (1)$$

where, V_0 is the present value of previous money, V_t is the value at time t, i is the interest rate/bank rate, and t is the number of years.

Finally, the following equation is used to obtain the cost benefit ratio:

$$B_{cr} = \sum_0^t R_t(1+i)^t / \sum_0^t C_t(1+i)^t \quad (2)$$

where, B_{cr} is the benefit cost ratio, R_t is the cash receipt at the end of year t, C_t is the investment at the end of year t, i is the bank rate/interest rate, and t is the number of years.

Results and discussion

Socio-economic condition of Khasia community

The average family size of the Khasia community is 7.68. There are no families with less than three members. The larger family size is due to the presence of combine family in the community. Number of people in the age class 10−20 was the highest in the population and accounted for 24.85% of the total population of the area. The highest percentage of the age class 10−20 indicates the rapid rise in young population in the study area. Surprisingly the literacy rate of Khasia community was 100%, and 50% of the total respondents were educated up to secondary level. This extremely high literacy rate may be due to the financial viability of the community and socio-economic development. According to land holding classification by BBS (Bangladesh Bureau of Statistics), 54.54% of the landowners of Khasia fall in the medium category (1.01−3.03 ha) of the land ownership, followed by 27.26% and 18.18% for larger and smaller land owners, respectively. The mean annual household income of Khasia is Tk. 115 092. Betel leaf based agroforestry is a very common source of income where 95.45% households involved betel cultivation. About 63.64% of the family practice agriculture along with betel leaf plantation. Businesses and services are other sources of income. Betel leaf, betel nut, fruits, fuelwood, ginger and pineapple are the components making up the total agroforestry income where betel leaf contributes 79.73% (Table 1) of the agroforestry income and 29.23% of the total income of the Khasia.

Table 1. Contribution of different components to total agroforestry income in Jaintapur upazila in the district of Sylhet, Bangladesh

Agroforestry components	Income per year (Tk.)	Percentage (%) contributing to total agroforestry income
Betel leaf	269 219	79.73
Betel nut	18 865.5	5.59
Fruits	6 288.5	1.86
Fuelwood	31 442.5	9.31
Pineapple and zinger	4 872.5	3.45

Betel leaf based agroforestry system

The Khasia practices betel leaf based agroforestry both in homegarden and in the forest. This practice does not involve slash and burning process rather it conserve the existing vegeta-

tion along with betel leaf plants.

Host trees for betel leaf cultivation

The betel leaves climb on forest trees originating from natural regeneration. The Khasias also plant a wide range of species for growing betel leaves. About 16 species of host plants have been identified in betel leaf plantations. Along with the host trees, Turmeric (*Curcuma longa* L.), Ginger (*Zingiber officinale* Rosc.), Elachi (*ellettraria cardamomum* Mator.), Lemon *(Citrus limon (linn) barm f*), Pine apple (*Ananas commosus* (L) Merr.) and sometimes climbing vegetables are also planted in the betel leaf plantation area.

Management system

Khasias depend on indigenous knowledge and technology to cultivate betel leaf. They have no scientific knowledge regarding planting pattern, spacing and species selection for host plant, protection from insect and pest, and subsequent operation in betel leaf based agroforestry system. However, Khasia at first prepare the site in the jhum area. Site preparation involved in clearing the area properly to expose the top soil. All the cutting vegetations obtained from clearing process were gathered around the base of the host trees. This process is called mulching. These organic materials were converted into fertilizer that provide nutrient to both host trees and betel leaf plants. As a result application of organic fertilizer is seldom done. Moreover, the forest land is very fertile in the study area.

After site preparation the planting materials are prepared. Planting materials are generally collected from the old betel leaf plantation. In most cases they collect these materials from their relatives who engaged in betel leaf plantation. Sometimes they buy these materials or collect free of cost from their neighbors. Khasia use vegetative parts as propagating materials. The old betel leaf plants are cut into 45–60 cm long stems with two or three nodes. The stems are planted into 15–20 cm deep pit slightly inclined to the ground under the host plants. June- July is the best time for betel leaf plantation.

The rotation of betel leaf is a period of eight years. The productivity of betel leaves over eight years drastically decreases. Plucking starts after 2−2.5 years of planting. In the meantime regular weeding is done. Weeding frequency varies three to four times per year. Pruning of host trees is done every year in February-march. The pruned branches are gathered on the base of the host trees to conserve moisture and add nutrients to the soil. Plucking is done 3−4 times in a year. July to August is the highest productive season.

Procurement of betel leaf

Plucking of betel leaves is done manually using simple instruments such as a Dao knife, baskets, and ladders. Sometimes Khasisa climb the trees and tie a stick with rope at the tree stem to support his weight. Another rope is tied around the climber and the tree. After plucking the leaves are washed with stream water available in the plantation area. Then they prepare Mora/Kanta. A Mora contains 200–250 betel leaves. All the Moras are arranged in a Khachi, a bamboo made basket of less weight. The leaves are then ready for sale.

Marketing channel

Marketing of betel leaf is slightly complex in the study area. Rashed (2005) mentioned that marketing of betel leaves involved a long and complex chain of intermediaries. This complexness may be due to the lack of good communication in the study area. Poor communication and transportation facilities, highly segregated markets and unequal bargaining powers between buyers and sellers make the field more profitable for middlemen (FAO 1995). Due to lack of proper communication system in Jaintapur, high involvement of middlemen in marketing of betel leaf is reported. The producers sell betel leaves to the local wholesaler. The wholesalers sell the products to the retailer. Sometimes the producers directly sell their products to the retailer. The retailers sell the products in the local market from where the consumers easily buy it. The local wholesalers do not always sell their products to the retailer. Sometimes they transport the products to district sadar and sell them to district agent from where betel leaves are distributed through district level wholesaler, sub-district level wholesaler and retailer (Fig. 1). Due to lack of information gap regarding the price system and adoption of appropriate pricing system, the producers do not get the proper price of their products.

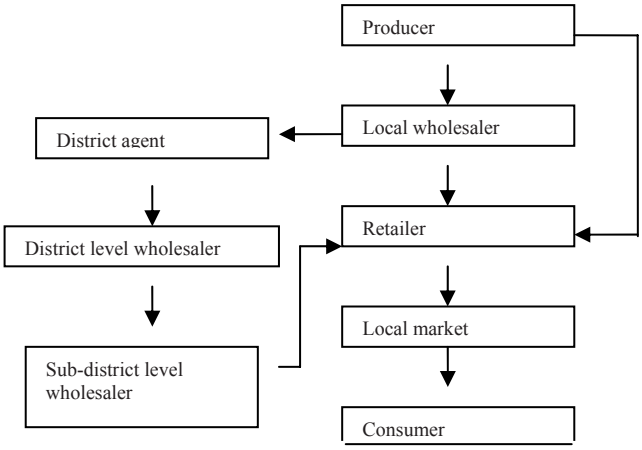

Fig. 1 Marketing channel of selling betel leaf in Jaintapur upazila in the district of Sylhet, Bangladesh.

Financial analysis

Cost of betel leaf production involved in collection of planting materials, site preparation, pruning of host trees, weeding, plucking and procurement of betel leaves. The cost varies slightly from place to place. On the other hand, benefits obtained from selling betel leaf, betel nut, fruits, fuelwood, zinger, pineapple and other non-timber forest products. Comparatively high cost was involved at the beginning of the production because inten-

sive site preparation needed (Table 2).

Table 2. Schedule of cost and benefit for one hectare of lands in betel leaf based agroforestry system (Value in Tk.*) in Jaintapur upazila in the district of Sylhet, Bangladesh.

Year	Cost items (Tk.)						Benefit items (Tk.)					
	Planting materials	Site preparation	Pruning of host trees	Weeding	Plucking and procurement	Total	Betel nut	Fuelwood	Fruits	Pine apple and zinger	Betel leaf	Total
1st	2471	9884	3706.5			16061.5	3706.5	6177.5	1235.5			11119.5
2nd			2965.2	6177.5	1235.5	10378.2	3706.5	6177.5	1235.5	6177.5	2471	19768
3rd			2965.2	6177.5	2965.2	12107.9	3706.5	6177.5	1235.5	4942.0	37065	53126.5
4th			2965.2	6177.5	5683.3	14826.0	3706.5	6177.5	1235.5	4942.0	74130	90191.5
5th			2965.2	6177.5	11119.5	20262.2	3706.5	6177.5	1235.5		123550	134669.5
6th			2965.2	6177.5	7413	16555.7	3706.5	6177.5	1235.5		98840	109959.5
7th			2965.2	6177.5	6177.5	15320.2	3706.5	6177.5	1235.5		79072	90191.5
8th			2965.2	6177.5	5683.3	14826.0	3706.5	6177.5	1235.5		61775	72894.5

* Tk. 70=1 US Dollar

Benefit obtained from betel leaf production was less than the cost as no betel leaf was produced in the first year. Thus the net benefit in the first year was negative (Table 3). In the second year, plucking of betel leaf started to a very little extent. As a result the benefit increased, On the other hand, the cost of production decreased after the first year as no additional site preparation was required (Fig. 2) and the cost involved only in the weeding, pruning of host trees, and plucking and procurement of betel leaves. From the third year, the cost increased again due to increase of plucking and procurement cost. The benefit also increased because of increasing production of betel leaf up to the fifth year (Fig. 2). From the sixth year, both cost and benefit decreased at a slow rate. After the eighth year, the production decreased drastically for the reason that the farmers were reported to fix rotation at this year. A comparison of cost incurred and benefit obtained per year from one hectare of betel leaf plantation was shown as Fig. 2. The total net cost of production up to the rotation period was estimated to be Tk. 186492.8 and the total revenue Tk. 834328.2. Hence the net revenue after eight years was estimated to be Tk. 647835.4. The ratio of benefit to cost was calculated to be 4.47 and the mean annual income from one hectare of betel leaf plantation was estimated to be Tk. 80979.38. Therefore, it is evident that the betel leaf based agroforestry production system is highly profitable.

Table 3. Net benefit and ratio of benefit to cost for one hectare of lands in betel leaf based agroforestry system (Value in Tk.*) in Jaintapur upazila in the district of Sylhet, Bangladesh.

year	Cost of production	Revenue	Compounding factor	Compounded cost	Compounded revenue	Net compounded return	Ratio of benefit to cost
1	16061.5	11119.5	2.14	34435.86	23840.21	-10595.6	
2	10378.2	19768.0	1.95	20227.11	38527.83	18300.72	
3	12107.9	53126.5	1.77	21430.98	94033.91	72602.92	
4	14826.0	90191.5	1.61	23869.86	145208.30	121338.50	4.47
5	20262.2	134669.5	1.46	29663.86	197156.10	167492.30	
6	16555.7	109959.5	1.33	22019.08	146246.10	124227.10	
7	15320.2	90191.5	1.21	18537.44	109131.70	90594.27	
8	14826.0	72894.5	1.10	16308.60	80183.95	63875.35	
Total				186492.80	834328.20	647835.40	

Tk. 70 = 1 US Dollar

Conservation role of betel leaf based agroforestry system

The existing trees and shrubs in the agroforestry system in the jhum are carefully maintained as host trees for growing betel leaf. Many timber and horticultural species are planted to provide more space for betel leaf plants. Moreover intercropping plants and other vegetables are also planted in betel leaf plantations, including banana (*Musa sapientum*), Turmeric (*Curcuma longa* L.), Ginger (Zingiber officinale Rosc.), Elachi (*ellettraria cardamomum* Mator.), Lemon *(Citrus limon (linn) barm f*), Pine apple (Ananas commosus (L) Merr.), oranges (*citrus auruntium* linn). The Khasisa protect the forest from grazing, browsing,

trampling and human interference, which facilitate natural regeneration. Growing of fruit trees attracts different types of birds and provides a suitable habitat for them. In short, these means betel leaf based agroforestry practices help conserve biological diversity along with income generation.

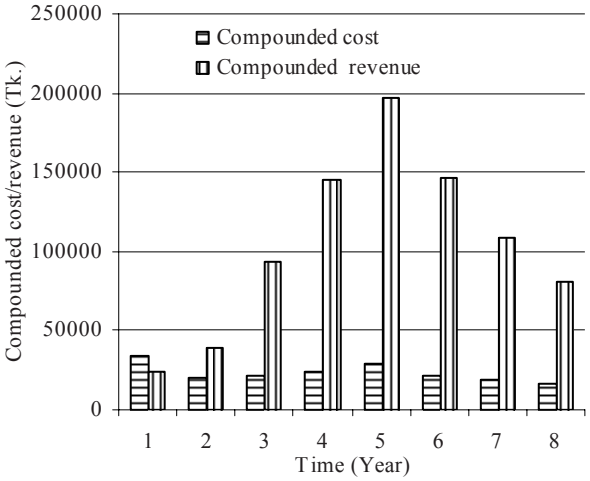

Fig. 2 Comparison of cost incurred and benefit obtained per year from one hectare of betel leaf plantation area up to rotation age in Jaintapur upazila in the district of Sylhet, Bangladesh.

Species composition of Khasia homegarden

The homegardens of Khasia are species-rich. Fifteen timber species, 22 horticultural species, six medicinal species, 13 annual crops including leafy vegetables, seven species of spices and five species of bamboo were recorded along with betel leaf. Cane and Patipata were also found to grow to a small extent in a number of homegardens. The bamboos were reported to grow at the back yard of the house, sometimes along with cane and patipata. The timber and horticultural species are generally artificially planted by the farmer with a few species grow naturally. In general farmers practice traditional management based on indigenous knowledge and technology in homegardens. However, good quality planting materials are not available to them. Due to lack of sufficient reliable sources of quality planting materials, they can only use seeds and seedlings as planting materials that they collect from last year self stock or from the neighbors. Sometimes the farmers had to buy seeds or seedlings from the local market. They generally do not follow vegetative reproduction except with betel leaf production. The quality of most species is deteriorating due to use of the low quality seed for reproduction, consequently the total outcome from homegarden is decreasing. An international Non-Government Organization (NGO) through Inter Cooperation (IC), has taken a program to ensure the supply of good quality planting materials throughout the country funded by The Swiss Agency for Development and Cooperation (SDC). But this is not sufficient. Fortunately, BRAC recently initiated Tree Improvement Programme (TIP) in Jaintaput, Sylhet, which might play an important role in the supply of quality planting materials to the farmers.

Conclusion and recommendations

The Khasia mainly depend on the betel leaf based agroforestry system for their livelihood. Their main earning sources come from agriculture and betel leaf cultivation. They used to practice agroforestry farming system both in homegarden and jhum land/forest. In Bangladesh, betel leaf is cultivated on relatively small proportion of land. Total cultivated area in the agroforestry system in Bangladesh is about 14 175 ha and the total annual production is about 72 500 tons (Islam 2004). The average yield per hectare is 5.61 tons. The betel leaf based agroforestry practiced by Khasia meets 50% of the domestic demand for betel leaf and employ a sizable labor force (Saha and Azam 2004). Betel leaf production yields high income though it is capital intensive in a limited area. Moreover, betel leaf plants are resistant to insect and pest attacks. Therefore, income from betel leaf is very stable. This type of agroforestry system is not only a means of income generation but also may be a tool for forest conservation, because the natural trees and shrubs in the agroforestry system are managed and also planted artificially for creeping of betel leaf plants. Khasia community is thus playing an important role in the national economy of the country, conservation of biological diversity and amelioration of environment. But the Khasisa in the country particularly in Jaintapur, Sylhet, are in a stressed condition in term of having land and property rights and many other socio-cultural and demographic issues.

The Khasia community practice agriculture, homegarden and betel leaf based agroforestry following the traditional age-old systems and tools. Due to lack of proper price system and better communication, the farmers do not get the reasonable price of their product. To date, less attention has been given by the government or NGOs to improve their livelihood. Moreover, very little research has been undertaken to improve their homegarden and betel leaf based agroforestry system. To improve the productivity both from homegarden and betel leaf based agroforestry system and make the systems sustainable, the following recommendations can be proposed:

1. Proper training should be given to the farmers about systematic agroforestry farming system. The training may include the knowledge about planting pattern, spacing and species selection, protection from insect and pest, and appropriate tending operation.

2. Supply of good quality planting materials should be ensured both by the government and by NGOs. Establishment of private nurseries with the assistance of the Forest Departments should be encouraged.

3. Modern technologies should be introduced to increase the productivity of the system.

4. Proper price system should be developed to avoid the exploitation by middlemen.

5. Infrastructural facilities such as construction of road and bridges, transportation and communication facilities should be developed to facilitate marketing of betel leaf and other products.

6. As betel leaf production is capital intensive and involve

high initial cost, loan facilities for the farmers should be provided both by government financial agencies and by NGOs.

7. Government initiative and appropriate intervention is necessary to improve the productivity of betel leaf based agroforestry farming system and to improve the system's sustainability.

8. Adequate research should be undertaken to recommend appropriate design of agroforestry in homegarden and in the betel leaf plantation area in the forest.

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